CHEM 755 Mechanisms of Organic Chemistry (3 hours) Prerequisite: Organic Chemistry (two semesters). A study of mechanistic aspects of organic reactions included the rate theory, and reaction mechanism, experimental methods and treatment of data.

CHEM 758 Quantum Chemistry (3 hours) Prerequisite: Physical Chemistry (two semesters). (Computational Chemistry) Important concepts of quantum chemistry at the intermediate level, including angular momentum, perturbation theory, electronic structure of molecules, and radiation matter interaction. Applications will vary from year to year.

CHEM 763 Statistical Mechanics (3 hours) Prerequisite: Physical Chemistry (two semesters) A study of statistical mechanical ensembles, partition functions and their relationship to thermodynamics, lattice statistics, molecular distribution and correlation functions, the theories of liquids and solutions, phase transitions, and cluster theory.

CHEM 780 Dissertation - (1 - 9 hours)

CHEM 782 Special Topics in Analytical Chemistry - (3 hours) Selected topics not covered in regularly scheduled courses, and current research topics in analytical chemistry.

CHEM 783 Special Topics in Biochemistry - (3 hours) Selected topics not covered in regularly scheduled courses, and current research topics in biochemistry.

CHEM 784 Special Topics in Organic Chemistry - (3 hours) A course in a specific area of organic chemistry such as structure determination in organic chemistry, or current research subject not covered in regularly scheduled courses presented to fit the interests of advanced students.

CHEM 785 Special Topics in Inorganic Chemistry - (3 hours) Topics include subjects of current research in inorganic chemistry, but not covered in regularly scheduled courses.

CHEM 786 Special Topics in Physical Chemistry - (3 hours) Topics vary from year to year will include subjects such as photochemistry, solid state, surface chemistry, and radiation chemistry.

DEPARTMENT OF MATHEMATICS

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Dr. Y. Pan, Professor

The Department of Mathematics in the School of Science and Technology in cooperation with the School of Education offers a program leading to the Master of Science in Teaching (MST) degree, in mathematics. This department also offers a master of Science (MS) degree in pure mathematics for students who seek careers in college or university teaching, government, industry, business, etc.

Based on the certification requirements of the State of Mississippi as stated in *Bulletin 130,* and upon the stated principles and guidelines of The National Council of Teachers of Mathematics, The Mathematics Association of America, and The Mississippi Council of Teachers-Mathematics, the successful candidate for graduation with the MST degree should be able to perform the following competencies:

1. Expose students to various teaching aids in teaching and learning of mathematics at the junior high, high school, and college levels.
2. Show the basic structure of an idea by means of displays and examples.
3. Explain abstract ideas and relate them to concrete models by using the most modern techniques.
4. Bring ideas together to form new concepts in mathematics.
5. Turn ideas into words by means of displays, diagrams, and examples. Improve the oral and written expression of students in mathematics.
6. Stimulate a greater interest in mathematics to improve the performance of students. Share the idea of teaching and learning with other teachers in the field of mathematics by being active in professional organizations.
7. Properly counsel students in the field of mathematics.
8. Supervise programs in mathematics education.
9. Provide the kind of experiences in mathematics that will be relevant to the needs of today's youth.

10. Construct programs in mathematics that meet the needs of students in modern schools.
11. Demonstrate the nature of problem solving , proofs and processes involved in the solution of problems, and proofs of theorems in general.

These degree programs are designed for persons with an adequate background in mathematics and who wish additional preparation for mathematics teaching or mathematics supervision.

Admission Requirements

Admission to a graduate program in mathematics requires at least 15 semester hours of undergraduate mathematics above the regular calculus sequence.

Master of Science in Teaching Degree

Retention Requirements

By the end of the first semester, students should have taken the Graduate Record Exam (G.R.E.) and the Graduate English Competency Exam

Degree Requirements

1. Thirty six (36) hours are required with a thesis, i.e. ten (10) courses plus six (6) hours for a thesis.
2. Thirty six (36) are required with a project, i.e. eleven (11) courses plus three (3) hours for a project.
3. Thirty six (36) hours are required if neither a thesis nor a project is done.
4. A "B" average is required for graduation.

Core Educational

Courses	Titles	Semester Hours
EDFL 511	History and Philosophy of Education (R)	3
EDFL 515	Methods of Educational Research (R)	3
EDFL 514	Elementary Statistics (R*)	3
EDFL 568	Curriculum Methods (R)*	3
	Total Hours	*15*

(R)- Required
(R*) -Required for students without an undergraduate Statistics course, and it is a prerequisite for EDSE 515.

Required Courses

Math 501	Topics in Geometry	3
Math 510	Topics & Issues	3
Math 511	Basic Algebra I	3
Math 513	Linear Algebra I	3
Math 531	Basic Real Analysis I	3
	Total Hours	15

Other Requirements

Math elective		3
Math 590	Thesis or	
Math 584	Independent Study (Project)	3
	(and 3 hrs. from List I), or	
Six hours from List I and three hours		
	from List II or List III	9
	Total Hours	36

List I

Math 503	Foundations of Mathematics I	3
Math 504	Foundations of Mathematics II	3
Math 512	Basic Algebra II	3
Math 513	Linear Algebra I	3
Math 514	Linear Algebra II	3
Math 532	Basic Real Analysis II	3
Math 541	Basic Complex Analysis I	3
Math 542	Basic Complex Analysis II	3
Math 561	Basic Probability and Statistics I	3
Math 562	Basic Probability and Statistics II	3
Math 551	Basic General Topology I	3
Math 552	Basic General Topology I-II	3
Math 581	Number Theory I	3
Math 582	Number Theory II	3

List II

Math 505	Mathematics for Secondary Teachers	3
Math 506	Basic Concepts for Teachers	3
Math 507	Basic Concepts for Teachers	3
Math 509	Mathematical Structures	3
Math 519	Topic in Mathematics Education I	3
Math 520	Topics in Mathematics Education II	3

List III

CSC 511	Computers and Programming	3
CSC 512	Intro. to Computer Systems and Organ.	3
CSC 515	Data Structures and File Management	3
CSC 518	Principles of Operating Systems	3
CSC 531	Com.Simulation Methods and Models	3
CSC 561	Probability and Statistical Inference I	3

MASTER OF SCIENCE

Retention Requirements

By the end of the first semester, students should have taken the Graduate Record Exam (G.R.E.) and the Graduate English Competency Exam

Degree Requirements

1. Thirty six (36) hours are required with a thesis, i.e. ten (10) courses plus six (6) hours for a thesis.
2. A "B" average is required for graduation.

Core Courses

Course	Title	Hours
Math 511	Basic Algebra I	3
Math 513	Basic Abstract Algebra I	3
Math 531	Basic Real Analysis I	3

Math 541	Basic Complex Analysis I	3
Math 551	Basic General Topology I	3
Math 599	Thesis	6
Electives- Three (3) courses from the list below:		
Math 501	Topics in Geometry	3
Math 503	Foundations of Mathematics I	3
Math 512	Basic Algebra II	3
Math 514	Linear Algebra II	3
Math 542	Basic Complex Analysis II	3
Math 552	Basic General Topology II	3
	Elective	3
	Total Hours	36

A student may concentrate in Applied Mathematics by taking the four (4) elective courses from this list: Math 513, 514, 541, 542, CSC 511, 512, 515, 518, 531, 561.

A concentration in Foundations of Mathematics consists of four (4) courses from this list: Math 501, 503, 513, 541, CSC 511, 512, 515, 518, 531, 561.

Notes

1. The Class 'A' Certificate must be held before receiving the Class 'AA' Certificate.
2. Math courses should be taken first because of their sequential nature, and the fact that they are not offered every term. However, Core Educational Courses are offered every term.
3. File Form II—Petition for Graduate Degree Candidacy if at least 15 semester hours have been completed.
4. File Form III—Application for Degree before the dates listed in the Graduate Calander for May and August graduations.
5. File Form IV—Application for Clearance following the completion of all work.

DESCRIPTION OF COURSES

MATH 500 Mathematics for Elementary Teachers. (3 Hours) Prerequisite:Approval of department. A course emphasizing content and techniques employed in the teaching of mathematics in the elementary school . Stress is placed on current trends and philosophy, content and methodologies.

MATH 501 Topics in Geometry. (3 Hours) Prerequisite: Approval of department. A survey of geometries and their structures. Emphasis is on both synthetic and analytic methods.

MATH 502 Topics in Algebra. (3 Hours) Prerequisite: Approval of department. An amalgamation of classical and modern theory, stressing the synthesis of ideas in areas from equation solvability, special algebraic forms (permutations, combinations, arrangements, binomial and multinomial theorems, partial fractions, progressions, groups, rings, domains of integrity, and ideas of interest).

MATH 503-504 Foundations of Mathematics I-II. (3-3 Hours) The fundamental elements of set theory and finite mathematical structures; cardinals and ordinals; logical deduction, elements of probability; vectors and matrices, linear programming, theory of games and applications.

MATH 505 Mathematics for Secondary Teachers. (3 Hours) Prerequisite: Approval of department. The basis of the content, philosophy and methodology employed in the teaching of secondary school mathematics is of prime interest here.

MATH 506-507 Basic Concepts for Teachers I-II. (3-3 Hours) Prerequisite: Approval of department. Higher mathematics for teachers reviewing the fundamental areas of algebra, geometry and analysis, with stress on rigor and validity of ideas.

MATH 508 Elementary School Topics. (3 Hours) Special topics and problems of elementary school mathematics and its teaching.

MATH 509 Mathematical Structures. (3 Hours) A course surveying the ideas of algebras, geometries, topology, set theory and other areas of interest. The course serves to strengthen the foundations of the learner, as well as to provide a rigorous basis for the areas under discussion.

MATH 510 Topics and Issues in Mathematics. (3 Hours) This course is designed for in-service teachers who are interested in the renewal of teaching licenses and the pursuit of graduate studies in the teaching of mathematics. Emphasis is on individualized research dealing with the stages of development of mathematics, new trends in the teaching of mathematics, and the exploration of teaching theories resulting from the work of experimental psychologists such as Piaget, Aushel and Bruner. Because of the individualized nature of the course, students with diverse backgrounds in mathematics can be accommodated.

MATH 511-512 Basic Algebra I-II. (3-3 Hours) Groups, (homomorphisms), rings, integral domains, modules and fields, elementary linear algebra, number theory.

MATH 513-514 Linear Algebra I-II. (3-3 Hours) Vector spaces, matrices, linear transformations, determinants and linear equations. Selected topics on eigenvalues, canonical forms, inner products, inner product spaces, bilinear and quadratic forms.

MATH 515-516 Abstract Algebra III-IV. (3-3 Hours) Prerequisite: Mathematics 512. Special topics in groups, rings and fields, factorization theory, extensions of rings and fields, modules, elementary theory of fields.

MATH 517-518 Topics in Mathematics Education I-II. (3-3 Hours) Elementary. Counting and numerical concepts, problem solving, equipment, achievement, examinations.

MATH 519-520 Topics in Mathematics Education I-II. (3-3 Hours) Secondary. Aims and problems, techniques, arousing and maintaining interest, aids and trends, tests and measurements, traditional and non-traditional courses, operation, geometry.

MATH 521-522 Basic Geometry I-II. (3-3 Hours) Prerequisite: Mathematics 511, concurrent enrollment or approval of department. Historical development; sets and projective planes and geometries; vectors, transformations, axiomatic affine, projective and plane geometry.

MATH 523-524 Modern Geometry III-IV. (3-3 Hours) Prerequisite: Mathematics 523 or approval of department. Motions and transformations, projective and topological transformations, projective plane, analytic projective geometry; absolute, ordered, affine and hyperbolic geometries; elementary differential geometry, topology of surfaces.

MATH 525-526 Introduction to Differential Geometry I-II. (3-3 Hours) Prerequisite: Mathematics 523 or approval of department. Curves and surfaces in three dimensions by classical methods, introduction to corresponding problems in n-dimensions involving tensor methods.

MATH 527-528 Projective Geometry I-II. (3-3 Hours) Prerequisite: Mathematics 512 or approval of department. The projective plane, polarities and conic sections, affine geometry, projective metrics, non-Euclidean Geometry, spatial geometry.

MATH 529-530 Systems Analysis I-II. (3-3 Hours) Prerequisite: Approval of department. An analysis of the numerical and abstract systems of mensuration. Stress is placed on the metric and English systems, conversion analysis and other systems of interest.

MATH 531-532 Basic Real Analysis I-II. (3-3 Hours) Prerequisite: Mathe 511 or approval of department. Metric spaces, regulated functions and integrals; integrals of Riemann and Lebesque; trigonometrical and Fourier Series; differentiation and Stieltjes Integrals.

MATH 533-534 Advanced Analysis I-II. (3-3 Hours) Prerequisite: Mathematics 532 or approval of department. Further treatment of limits, continuity, differentiability and integrability of functions of one and more variables. Infinite series and products, power and trigonometric series; selected topics.

MATH 535-536 Introduction to Measure and Integration I-II. (3-3 Hours) Prerequisite: Mathematics 531 or approval of department. Lebesgue measure of linear sets, measurable functions, definite integral, convergence, integration and differentiation, spaces of functions, orthogonal expansions, multiple integrals and the Stieltjes Integral.

MATH 537-538 Introduction to Functional Analysis I-II. (3-3 Hours) Prerequisites: Mathematics 512, 531, or approval of department. Fundamentals of the theory of vector spaces; Banach spaces; Hilbert spaces. Linear functionals and operators in such spaces; spectral resolution of operators, applications.

MATH 539-540 Infinite Series I-II. (3-3 Hours) Prerequisites: Mathematics 511 and approval of department. Complex numbers, sets and functions; limits and continuity; analytic functions of a complex variable, elementary functions; integration; power and Laurent series, calculus of residues, conformal representation, special topics.

MATH 541-542 Basic Complex Analysis I-II. (3-3 Hours) Complex numbers, sets and functions; limits and continuity; analytic functions of a complex variable, elementary functions; integration; power and Laurent series, calculus of residues, conformal representation, special topics.

MATH 544 Entire Functions. (3 Hours) Prerequisite: Mathematics 541. Entire functions, maximum absolute value and order, zeroes of entire functions, fundamental theorem of algebra, Picard's Little Theorem, algebraic relationships and addition theorem; special theorems and functions.

MATH 545 Laplace Transforms. (3 Hours) Prerequisites: Math 534 and approval of department. The Stieltjes Integral; fundamental formulae; moment problem, Tauberian theorems, bilateral Laplace Transform, inversion and representation problems, the Stieltjes Transform.

MATH 546 Special Functions. (3 Hours) Prerequisites: Math 535 and approval of department. Infinite products, Gamma and Beta functions, series, polynomials, functions, relations and sets of analysis and differential equations.

MATH 547-548 Integral Equations I-II. (3-3 Hours) Prerequisites: Math 534, 542, and approval of department. Theory of Fredholm and Volterra equations; Hilbert-Schmidt theory; singular integral equations and some applications.

MATH 549-550 Methods In Applied Mathematics I-II. (3-3 Hours) Prerequisite: Approval of department. Elements of linear algebra; applications to systems of linear variables; function spaces; tensor analysis, applications to geometry, electromagnetic theory, Lagrangian and Hamiltonian formulations of mechanics; other topics of interest.

MATH 551-552 Basic General Topology I-II. (3-3 Hours) Prerequisites: Mathematics 223 and approval of department. Elementary set theory, ordinals and cardinals; topological spaces; cartesian products; connectedness; special topologies; separation axioms; covering axioms, metric spaces; convergence; compactness; function spaces; spaces of continuous functions and complete spaces; homotopy; maps into spheres; topology of En; homotopy type; introduction to algebraic topological ideas.

MATH 553-554 Introductory Algebraic Topology I-II. (3-3 Hours) Prerequisites: Mathematics 552 and approval of department. Complexes, simplicial,

singular and Cech Homology Theory. Homotopy groups and basic theorems of algebraic topology.

MATH 555-556 Combinatorial Topology I-II. (3-3 Hours) Prerequisites: Mathematics 553 and approval of department. Properties of topological spaces; Jordan's theorem, surfaces, complexes, coverings, dimension; the Betti Groups, homology theory, manifolds, the duality theorems, cohomology groups of compacta, introduction to theory of continuous mappings of polyhedra.

MATH 557-558 Introduction to Algebraic Geometry I-II. (3-3 Hours) Prerequisites: Mathematics 512, 521, or approval of the department. Algebraic preliminaries, local rings valuation theory, power series, rings, geometry of algebraic varieties with emphasis on curves and surfaces.

MATH 559-560 Linear Programming I-II. (3-3 Hours) Basic Concepts, graph theory, theory of games, Markov Chains, Leontief Economic Models, Optimizing linear functions of variables subject to constraints, a geometric approach, simplex method, convex sets duality, applications.

MATH 561-562 Basic Probability and Statistics I-II. (3-3 Hours) Prerequisite: Mathematics 532 or approval of department. Basic concepts of measure theory and integration axiomatic foundations of probability theory, distribution functions and characteristics functions, central limit problem, modern statistical inference, analysis, variance, decision functions.

MATH 563-573 Design I-II. (3-3 Hours) Prerequisite: Mathematics 272. Experimental Design: Completely randomize design, randomize block designs, factorial experiments split plot design. confounding.

MATH 564 Linear Models. (3 Hours) Prerequisite: Mathematics 562 or departmental approval. Linear statistical models, some noise-reducing experimental designs, an example-of a volume-increasing design, fitting the general linear model, inference making, multiparameter hypothesis: the analysis of variance, the effect of coding on the analysis, seeking a maximum or minimum response, fractional factorial experiments and incomplete block designs, an example of a completely random model, mixed models.

MATH 565 Multivariate Analysis. (3 Hours) Prerequisites: Mathematics 562 and approval of department. General linear hypothesis; least square estimation; confidence regions, multiple comparison; analysis of complete layouts; effects of departures from underlying assumptions. Analysis of convariance.

MATH 566-566W Operations Research. (3-3 Hours) Prerequisite: Math 232, 355. Linear programming, network analysis, PERT-CPM, dynamic programming, queuing theory and decision analysis.

MATH 567-568 Nonparametric Statistics I-II. (3-3 Hours) Prerequisites: Mathematics 562 and approval of department. Problems of estimating testing hypotheses when the functional form of the underlying distribution is unknown. Robust methods; sign test, rank test and confidence procedures based on these tests; tests based on permutations of observations. Non-parametric tolerance limits; large sample properties of the tests, multisample problems; ranking methods in analysis of variance; Bivariate and multivariate procedures, efficience comparisons.

MATH 569-570 Functions of Several Real Variables I-II. (3-3 Hours) Prerequisites: Mathematics 533 and approval of department. Euclidean spaces, Mapping and differentials, manifolds, differential forms, vector analysis.

MATH 571-572 Numerical Analysis I-II. (3-3 Hours) Prerequisite: Approval of department. Approximation and interpolations; numerical differentiation, quadrature and summation; numerical solutions of ordinary differential equations; functional approximation techniques; solutions of equations; eigenvalues and eigenvectors.

MATH 573 Fractal Geometry. (3 Hours) Prerequisite: Math 511 or departmental approval. Metric spaces, equivalent spaces, classification of subsets, and the Space of Fractals. Transformations on metric spaces, contraction mappings, and the Construction of Fractals. Chaotic Dynamics of Fractals, Fractal Dimension. Fractal Interpolation. Julia Sets. Parameter Spaces and Mandelbort Sets. Measures on Fractals.

MATH 574 Numerical Linear Algebra. (3 Hours) Prerequisite: Approval of department. Elementary numerical analysis; matrix algebra; elimination and compact elimination methods; orthogonalization methods; condition, accuracy, and precision; comparison of methods; iterative and gradient methods; iterative and transformation methods for latent roots and vectors; error analysis for latent roots and vectors.

MATH 575-576 Approximation and Interpolation I-II. (3-3 Hours) Prerequisite: Approval of department. Interpolation, remainder theory; convergence theorems; infinite interpolation; uniform approximation; best approximation; least squares approximation; Hilbert space; orthogonal polynomials; closure and completeness.

MATH 577-578 Ordinary Differential Equation I-II. (3-3 Hours) Ordinary differential equations: basic theorems of existence, uniqueness, and continuous dependence of the solutions; linear differential equations and systems; stability theory; topology of integral curves; differential equations in the complex domain, asymptotic integration; boundary value problems. Partial differential equations; equations of first order method of characteristics, Hamilton-Jacobi theory; equations of second order-classification according to type; elliptic equations-potential equation, maximum principle, characteristics, and other topics of interest.

MATH 579-580 Partial Differential Equations I-II. (3-3 Hours) Prerequisite: Mathematics 577 or departmental approval. Linear equations with constant coefficients in two independent variables, applications, eigenfunction expansions, homogeneous and nonhomogeneous equations. Fourier series, existence, solution uniqueness and representation, Initial boundary value problems, Laplace's equation, special topics.

MATH 581-582 Number Theory I-II. (3-3 Hours) Prerequisites: Approval of department. Diophantine analysis, primes, residue classes, theorems of Euler, Fermat, and Wilson, Continued Fractions, Chinese Remainder Theorem, quadratic reciprocity, valuations, extensions of valuations, local and global fields, discriminant.

MATH 583 Advanced Number Theory. (3 Hours) Prerequisite: Mathematics 581 or departmental approval. Quadratic and Cyclotomic extensions, elementary class field theory, and selected topics.

MATH 584 Independent Study. (3 Hours) Prerequisite: Departmental consent. Intensive study and research of a subject selected in accordance with student needs and arranged in consultation with the staff. Topics will vary. Student will make periodic reports on his/her reading and will-prepare a scholarly paper on a problem.

MATH 585-586 Introductory Algebraic Number Theory I-II. (3-3 Hours) Prerequisites: Mathematics 512, 582, and approval of department. Valuations, fields of algebraic functions, cohomology of groans, local and global class field theory are introduced as topics.

MATH 586A Special Projects: Mathematics Curriculum Planning. (3 Hours) Prerequisite: Departmental consent. This course is designed primarily for inservice personnel in education desiring enrichment activities in mathematics curriculum planning K-12. Students taking this course will be engaged in activities directed toward planning, developing, and evaluating curricular materials that may be used for teaching grades K-12.

MATH 587 Introductory Analytic Number Theory. (3 Hours) Elements from prime number theory,prime number theory for arithmetic progressions,additive number theory, density theorems.

MATH 588-589 Sampling Methods I-II. (3-3 Hours) Prerequisite: Mathematics 272. Sampling methods: Simple random sampling, sampling for proportions and percentages, estimation of sample size, stratified random sampling ratio estimates.

MATH 590 Thesis. (3 Hours) The candidate for the Master of Science in Teaching degree must present a Thesis embodying the results of his research. The candidate chooses his problem, but approval by his adviser is required.

MATH 591-592 Basic Modern Logic I-II. (3-3 Hours) Prerequisite: Approval of department. Elementary introduction to classical first order theory (completeness, deduction theorem, Godel completeness, Herbrand's Theorem), presentation of basic model theory; axiomatic set theory, cardinal and ordinal numbers to the consistency results of Godel and the independence results of Cohen, Incompleteness Results (Godel's, Rossi's and Church's Theorem).

MATH 593 Theory of Models. (3 Hours) Prerequisites: Mathematics 592 and approval of department. Infinitary languages, ultraproducts, compactness, saturated structures, applications to mathematical theories; other topics as time permits.

MATH 594 Decidability and Undecidability. (3 Hours) Prerequisites: Mathematics 592 and approval of department. Godel's incompleteness theorem for arithmetic, recursive nonaxiomatizability of second-order logic, Church's Undecidability Theorem for first-order logic, decidable first-order theories; other topics as time permits.

MATH 595-596 Foundations of Set Theory I-II. (3-3 Hours) Prerequisite: Mathematics 591 or approval of department. Axiom systems, ordinal and cardinal arithmetic, model theory of set theory, constructible sets, relative consistency and independence of Axiom and Choice and generalized continuum hypothesis.

MATH 597-598 Theory of Recursive Functions I-II. (3-3 Hours) Prerequisites: Mathematics 592 and approval of department. Turing machines, recursive functions, recursive and recursively enumerable sets, Post's Problem and degrees of unsolvability, recursion theorem, lattice of r.e. sets, hierarchies.

MATH 599 Thesis. (3 Hours) The candidate for the Master's degree must present a Thesis embodying the results of his research. The candidate chooses his problem, but approval by his adviser is required.

MATH 600 Research. (3 Hours) Prerequisite: Department approval. Mathematics research.

MATH 611-612 Algebra I-II. (3-3 Hours) Prerequisite: Approval of department. Groups and operator groups; basic constructions; isomorphism theorems; Jordan-Holder theorem. Rings and ideals, polynomial rings and group rings; integral domains, factorization theory. Modules and vector spaces, linear mappings; theory of fields and field extensions; normal extensions; separability, Galois theory, finite fields, algebraic closure. Advanced topics.

MATH 613-614 Homological Algebra I-II. (3-3 Hours) Prerequisites: Mathematics 512 and approval of department. Categories, functions, spectral sequences, cohomology of groups. Abstract category theory.

MATH 615-616 Finite Groups I-II. (3-3 Hours) Prerequisites: Mathematics 512 and approval of department. Permutation representations. Sylow's theorems, commutator calculus, nilpotent groups; p-groups. Finiteness conditions; Burnside problem. Solvable groups; theorems of Hall and Cunihin. Special topics.

MATH 617-618 Ring Theory I-II. (3-3 Hours) Prerequisite: Mathematics 511 or departmental approval. Definition and examples of rings, some special classes of rings, homomorphisms, ideals and quotient rings, more ideals and quotient rings. The field of quotients and integral domains, Euclidean Rings, polynomial rings, polynomials over the rational field, polynomial rings over commutative rings, localization, principal rings, selected topics.

MATH 619-620 Universal Algebra I-II. (3-3 Hours) Prerequisites: Mathematics 512 and approval of department. Basic definitions. Subalgebras, congruences and homomorphisms. Direct products, lattices, Boolean algebras, Stone's representation theorem; varieties of algebras, free algebras; special topics.

MATH 621-622 Modern Geometry I-II. (3-3 Hours) Prerequisite: Approval of department. Geometries and their properties. Emphasis on properties and comparisons with systems. Analytic and synthetic projective geometry; structural systems. Advanced topics.

MATH 623-624 Differential Geometry I-II. (3-3 Hours) Survey of minimal surfaces, submanifolds, plateau's problem, Bernstein's problem; complex manifolds, Kahler metric. The Charn class. Albanese and Picard varieties. Holomorphic vector fields, automorphism group. Hodge manifolds.

MATH 625-626 Algebraic Geometry I-II. (3-3 Hours) A study in the plane, based on homogeneous point and line coordinates; a study of algebraic curves and envelopes, including such topics as invariants, singularities, reducibility, genus polar properties, Pascal and Brianchon theorems, and Jacobian, Hessian and Pluker Formulas.

MATH 629-630 Theory of Fields I-II. (3-3 Hours) Prerequisites: Mathematics 511, 512 or departmental approval. Extension fields, the transcendence of e, roots of polynomials, construction with straight-edge and compass, Galois Theory, solvability by radicals, real fields, absolute values, applications, selected topics.

MATH 631-632 Real Variables I-II. (3-3 Hours) Prerequisite: Mathematics 532 or approval of department. The Lebesgue integral, Function Spaces and Banach Spaces, Differentiation, integration of Product Spaces, Lebesgue Stieltjes Integral, linear functionals, implicit and inverse function theorems, Fubini's Theorem, Stokes' Theorem Lp classes; applications to Fourier Series.

MATH 633-634 Functional Analysis I-II. (3-3 Hours) Prerequisite: Mathematics 541 or departmental approval. Advanced Topics. Fundamentals of the theory of vector spaces, Banach Spaces; Functional equations; applications to fields of analysis. Non-linear problems. Schauder-Leray fixed-point theorem and its applications to fundamental existence theorems of analysis, convex sets and weak topologies, operators and their adjoints, semi-norms. Orthogonal projection and Liesz's Representation Theorem, the Hahn-Banach Theorems, normed ring, Ergodic and diffusion theory.

MATH 635-636 Ordinary Differential Equations I-II (3-3 Hours) Prerequisite: Mathematics 541. Approval of department. Existence theorem; linear systems; regular and irregular singular points; special topics.

MATH 637-638 Partial Differential Equations I-II. (3-3 Hours) Prerequisite: Mathematics 541. Approval of department. Classical theory of partial differential equations, together with an introduction to the modern theory based on functional analysis.

MATH 639-640 Theory of Integration I-II. (3-3 Hours) Prerequisite: Mathematics 632 or approval of department. Differentiation and integration, classical Banach spaces, abstract spaces, compact spaces, Banach spaces, measure and integration, measure and outer measure, the Daniell Integral, measure and topology, mappings and measurable spaces.

MATH 641-642 Complex Variables I-II. (3-3 Hours) Prerequisite: Approval of department. The plane and sphere of complex numbers, Differentiability and Cauchy-Riemann differential equations; Cauchy's integral theorem and integral formula. Series of analytic functions. Expansion in power series. Laurent expansion. Singularities, residue theorem, conformal mapping, Riemann mapping theorem, complex manifolds. Reflection principles, theorem of Mittag-Leffler product theorem of Weierstrass theorems of Runge and Poincare. Poisson's Integral Formula, other topics of interest.

MATH 643-644 Functions of Several Complex Variables I-II. (3-3 Hours) Prerequisites: Mathematics 642 and approval of department. Definition of homomorphic and meromorphic functions. Sequences of holomorphic functions. Analytic sets. Theorems of Cousin I, II, and Poincare. Kneser-Weierstrass integral. Functions of finite order, Jacobian Functions, Analytical continuation. Singularities of function and analytic sets on analytic sets. Integral representations of holomorphic functions. Envelopes of holomorphy. Complex manifolds and complex spaces; special topics.

MATH 645-646 Several Complex Variables I-II. (3-3 Hours) Prerequisites: Mathematics 644 and approval of department. Elementary properties of holomorphic functions. Local theory of homorphic functions and analytic sets. Analytic continuation. Coherent analytic sheaves. Cohomology with coefficients in sheaves. Stein spaces. Theorems A and B of Cartan. Theorems of Poincare and Cousin. Embedding theorems. Theorem of Runge. Envelopes of holomorphy, Levi's problem. Holomorphic maps. Compact complex spaces.

MATH 647 Entire Functions. (3 Hours) Prerequisites: Mathematics 642 and approval of department. First and Second Main Theorem of Nevanlinna. Functions of finite order. Hadamard's Theorem, functions of the exponential type. Functions of regular growth. Functions in the unit disk, Blasche Product. First and Second Main Theorem of Nevanlinna for functions for several variables, special topics.

MATH 649-650 Several Real Variables I-II. (3-3 Hours) Prerequisite: Mathematics 641 or approval of department. Necessary and sufficient conditions for an extremum, variations of Hamilton's Principle, the nonparametric problem of Bolza, parametric problems, direct methods, measure, integrals and derivatives, Lebesgue Integrals, Hamilton-Jacobi Theory, applications, nonclassical problems, selected topics.

MATH 651-652 General Topology I-II. (3-3 Hours) Prerequisite: Approval of department. Fundamentals of set theory, topological spaces, metric spaces, Function spaces and separation axioms. Complexes, homotopy and basic theorems in algebraic topology.

MATH 653-654 Algebraic Topology I-II. (3-3 Hours) Prerequisite: Mathematics 652 or 554. Approval of department. Fibre spaces, extension problems, obstruction theory.

MATH 655-656 Combinatorial Topology I-II. (3-3 Hours) Prerequisite: Mathematics 553 or departmental approval. Advanced properties of topological spaces, homology theory, cohomology groups of compacta, selected topics.

MATH 657-658 Differential Topology I-II. (3-3 Hours) Prerequisites: Mathematics 652 and 525 or 623. Study of differential manifolds from a viewpoint approximately midway between topology and differential geometry. Embedding manifolds in Euclidean spaces, transverse regularity of mappings, vector space bundles, universal bundles, characteristic classes, and the Thom Theory of Cobordism. Morse Theory of non-degenerate functions on a manifold, Morse Theory of geodesics, spherical modifications, theory of differentiable homotopy spheres, theory of handlebodies.

MATH 659-660 Algebraic Topology III-IV. (3-3 Hours) Prerequisite: Mathematics 654 or departmental approval. Sheaves and extraordinary cohomology theories, selected topics.

MATH 668 Topics in Statistics. (3 Hours) Prerequisite: Mathematics 562 or departmental approval. Topics in the advanced theory of statistics.

MATH 671-672 Advanced Numerical Analysis I-II. (3-3 Hours) Prerequisite: Mathematics 572 or departmental approval. Selected topics in advanced numerical analysis.

MATH 673-674 Approximation and Interpolation I-II. (3-3 Hours) Prerequisite: Mathematics 576 or departmental approval. Expansion theorems, degree of approximation of linear functions, selected topics.

MATH 677-678 Advanced Set Theory I-II. (3-3 Hours) Prerequisite: Mathematics 596 or departmental approval. Many equivalencies of the Axiom of Choice, selected topics.

MATH 681-682 Infinite Series I-II. (3-3 Hours) Prerequisite: Mathematics 540 or departmental approval. Selected topics are covered.

MATH 683-684 Theory of Summability I-II. (3-3 Hours) Prerequisite: Mathematics 539 or departmental approval. Advanced summability theory of series such as the Karamata-Lototsky-Jakimovski types, selected topics.

MATH 687-688-689 Research I-II-III. (3-3-3 Hours) Research in Mathematics.

MATH 690 Topics in Mathematics Education. (3 Hours) Prerequisite: Departmental approval. Selected topics are covered.

MATH 691 Topics in Algebra. (3 Hours) Prerequisite: Departmental approval.

MATH 692 Topics in Geometry. (3 Hours) Prerequisite: Departmental approval.

MATH 693 Topics in Real Analysis. (3 Hours) Prerequisite: Departmental approval.

MATH 694 Topics in Complex Analysis. (3 Hours) Prerequisite: Departmental approval.

MATH 695 Topics in Probability and Statistics. (3 Hours) Prerequisite: Departmental approval.

MATH 696 Topics in Number Theory. (3 Hours) Prerequisite: Departmental approval.

MATH 697 Topics in Numerical Analysis. (3 Hours) Prerequisite: Departmental approval.

MATH 698 Topics in Logic and Foundations. (3 Hours) Prerequisite: Departmental approval.

MATH 699 Dissertation. (3 Hours) Prerequisite: Departmental approval. Research in Mathematics.